A recent evaluation of Virginia EMS incidence reports indicates there is a significant (approximately 20%) increase in call time in underserved regions of Virginia compared to those in non-underserved regions (7).

			Call Time (Minutes)			
	Population	Strokes	Mean	SD	% (50^{th})	% (90")
Non-Underserved	5981866	7749	41.9	16.5	**38**	64
Underserved	1092360	1844	51.1	**26.5**	49	79
TOTAL	**1074226**	**9593**	**43.6**	**19.2**	**40**	**67**

Table 1 - Virginia EMS **Call Time** (Minutes) – **2003-2006**

Use of t-PA

Acute Ischemic Stroke (AIS) represents a significant (51%) proportion of total strokes in Virginia. Until the Centers for Medicare and Medicaid Services (CMS) reimbursement enhancement for treatment of AIS with t-PA (ICD-9 Procedure Code 99.10), the use rate in Virginia was 0.5%, which is below the national rate (2-5%) and far below the rate that some regions have achieved (20%). Beginning in October 2005, the time of the CMS reimbursement change, the t-PA use rate grew in Virginia to about 1.7%.

- Most of the use and growth in use of t-PA occurred in Primary Stroke Centers (4% t-PA use rate by September 2006) which are located in the central, northern and eastern portions of the state, with **no** service for populations residing in southwestern and southside Virginia.
- African American, female and patients over age 80 were less likely to receive t-PA than other races, men and patients under age 80

ORGANIZATION OF VIRGINIA'S STROKE SYSTEM

In **2005,** the Virginia Department of Health (VDH) partnered with the American Stroke Association (Mid-Atlantic Division) to form the Virginia Stroke Systems Task Force. One of the main goals of the Task Force was to rectify stroke care disparities by supporting a comprehensive project to strengthen the systems of care for stroke patients in Virginia. Meetings with stroke healthcare providers were convened to evaluate the state of stroke care. A team of experts was assembled and a comprehensive system-wide work plan was finalized (see Appendix **E)** to address each of the six core components of stroke care (Figure 6).

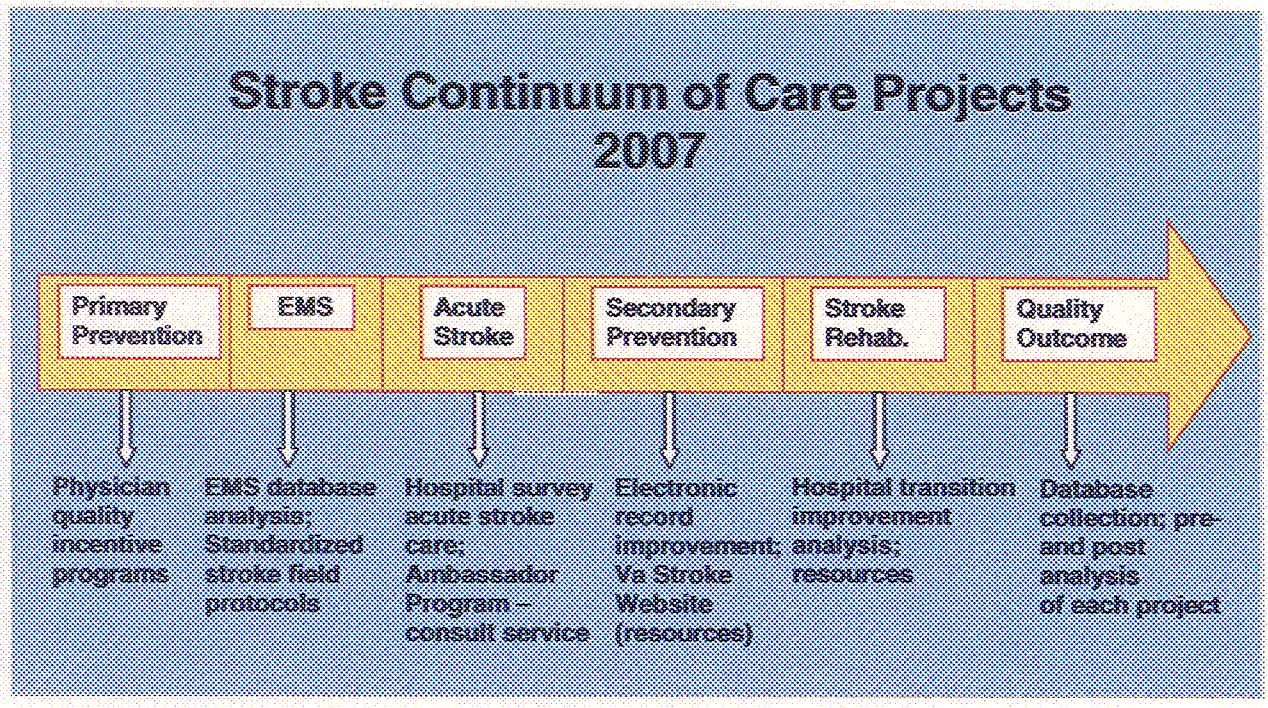


Figure 6 - The Stroke Continuum of Care Indicating the Importance of an Integrated Approach.

To assess acute stroke care, data was voluntarily submitted by 82 hospitals that had patients discharged with a primary diagnosis of stroke. Based on standardized evaluation criteria, each hospital was assigned a designation within the stroke system which matched their capabilities to deliver stroke care:

- Level 1- Comprehensive Stroke Center- highest level of capabilities, cutting-edge technologies/treatments
- Level 2- Primary Stroke Center- (based on Joint Commission Accreditation of Healthcare Organizations criteria)
- Level 3- Basic Stroke Care
- Level 4- Initial Entry Level Care- usually a very small facility with a low stroke volume and unable to support a full stroke program, but can triage patients and transport to a facility with greater capabilities.

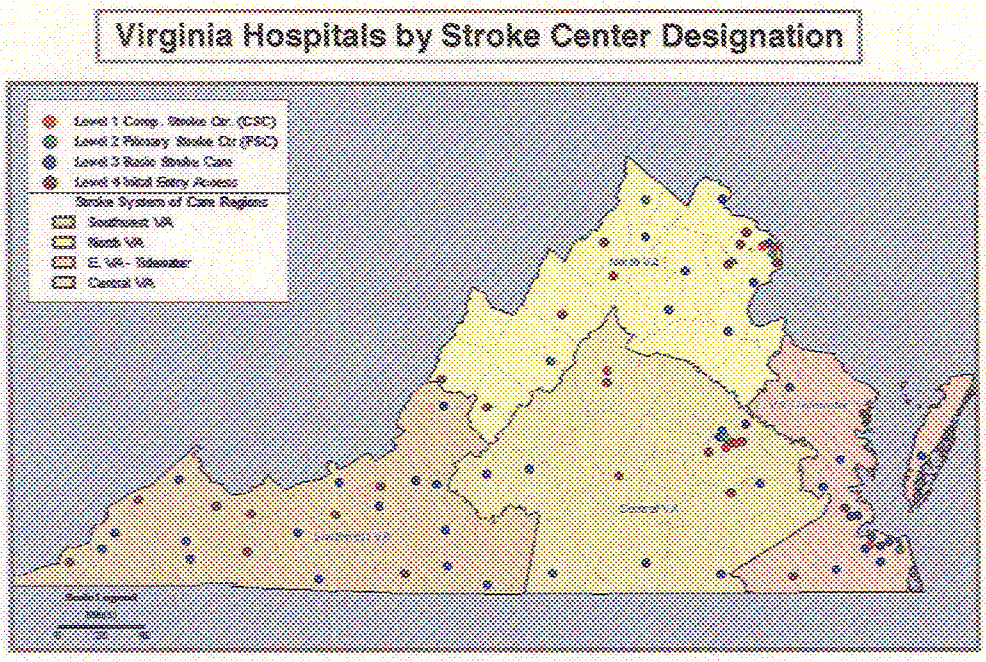


Figure 7 - Map of Virginia Acute Care Hospitals Based on Stroke Care Capabilities

Today, Virginia's Stroke Task Force is implementing the *Recommendations for the Establishment of Stroke Systems of Care* (8) through a statewide program administered in part through VDH and the American Stroke Association. The VDH Virginia Heart Disease and Stroke Prevention Project is one of eleven funded by the Centers for Disease Control and Prevention (See Figure 8). This critical program provides statewide basic patient education for primary and secondary prevention of stroke (treatment before and after the stroke) and supports physicians' education as well.

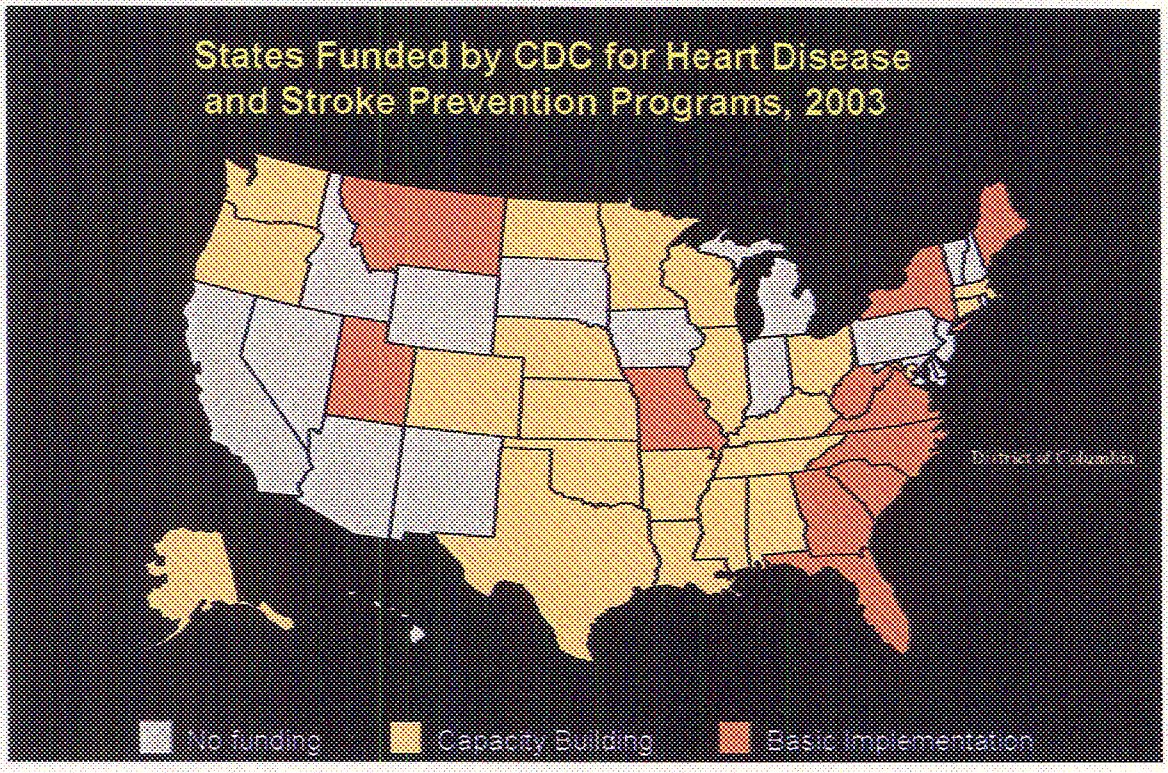


Figure 8 - CDC Funded Heart Disease and Stroke Prevention Programs, 2003

National guidelines recommend that a well-coordinated stroke system should promote *patient access to the full range of services through the continuum of care associated with stroke prevention, treatment and rehabilitation.* Therefore, initial targeted interventions include:

- Public awareness of the signs and symptoms of stroke
- Acute stroke treatment by first-responders and emergency room personnel
- Continuity of care between hospitals, rehabilitation centers and primary care providers

Efforts are now underway to design innovative strategies for improving stroke systems of care in Virginia. There are presently over 30 different programs throughout the stroke continuum of care. Highlights include the development of a Virginia Stroke Systems of Care stroke resources website and the launch of the Virginia Stroke Ambassador Program which is a forum of stroke experts who answer questions on stroke systems development (such as how to start building a Primary Stroke Center). In addition to these programs, the Virginia Stroke Systems Task Force would like to do more to reach rural and underserved areas of Virginia.

VIRGINIA'S SOLUTIONS

Virginia has documented that inadequate distribution of health resources along with geographic isolation, result in health disparities and poor health status for those living in *rural* and/or *underserved* areas. Some of the heaviest burdens appear to be in the Appalachian region with known poverty, lack of health insurance and physician shortages all contributing to poor overall cardiovascular and stroke care.

In reviewing stroke systems of care it is apparent that there are opportunities to make improvements in early detection, diagnosis and treatment of acute stroke. Specifically, there are geographical and professional bamers to accessing the expertise of primary stroke centers and significant underutilization of t-PA.

Recognizing these critical issues, the Virginia Stroke Systems Task Force has begun establishing programs to rectify these health care disparities and is looking for ways to better integrate technology into mainstream health systems. UVA and its partners are working with the Virginia Stroke Systems Task Force to develop solutions.

It is well known that information and telecommunications technologies (ICT) are being used today to support the management of health care. The use of ICT to electronically distribute healthcare data (text, images, voice and video) between healthcare providers, and between providers and patients to support the delivery of health care services and education is called *telehealth.* Broad in scope, it includes all stakeholders within a health care system **as** participants. Doctors, nurses, therapists, health educators etc, can all work with each other, and with their patients, regionally or on a statewide basis. Digital images and patient health data can be distributed over telecommunications networks at great distances to facilitate remote monitoring, diagnostic evaluation and consultation. Furthermore, telehealth applications can be used to deliver patient and provider education within healthcare institutions or even to their homes.

While UVA and other academic medical centers are providing remote specialty consultation and tele-radiology services, there is no particular focus on telehealth applications for stroke care within these existing telehealth programs or at the state level. The consensus is that this would be an excellent starting point for designing a telehealth network. In particular, a statewide telehealth network could significantly strengthen existing interventions by providing new alternatives to delivering stroke services to needy Virginians,

3.0 VA Acute Stroke Telehealth (VAST) Network

3.0 VIRGINIA ACUTE STROKE TELEHEALTH (VAST) NETWORK

Virginia will leverage the successes of existing acute stroke intervention programs and implement a multifaceted strategy that utilizes communication networks and telehealth applications to make improvements in stroke systems of care.

Acute stroke and the subsequent morbidities and mortality associated with stroke create a serious burden on America's health system, and in particular, in the Commonwealth of Virginia. With the aging of our population, and the significant increase in the incidence of the major co-morbidities and risk factors of stroke – diabetes, obesity, and hypertension – we are compelled to implement strategies to reverse this trend and provide timely state of the art care for our citizens.

While there is no one single solution to reducing the incidence of stroke or its complications, coordinated efforts amongst health care systems can make considerable impact through the design and implementation of innovative interventions leveraging telecommunications and information technology capabilities.

Telehealth/Telemedicine has been shown to effectively facilitate interventions that reduce the morbidity and mortality of stroke. States such as California, Georgia, Maryland, Massachusetts and Texas have well-established programs to facilitate the treatment of acute stroke and thereby mitigate its complications (9-16). Through video-based remote teleconsultation, the transmission of CT scans using teleradiology, and online exchange of medical records supported by real time consultation, highly-trained physicians at major stroke centers are able to share their expertise with other medical facilities. By leveraging this remote expertise, these outlying medical facilities with fewer local capabilities can be enabled to rapidly diagnose a stroke, and administer drugs, such as t-PA, within 3 hours of stroke onset, and significantly reduce the devastating effects of brain ischemia. In these states, this outreach capability is putting definitive stroke care within effective reach of greater numbers of our rural and underserved Americans.

In conjunction with this proposal, Virginia will leverage the successes of these other acute stroke intervention programs by implementing a multifaceted strategy that utilizes communication networks and telehealth applications to make improvements in stroke systems of care.

Operational Design of VAST

The FCC Rural Healthcare Pilot will fund the overlay of a telehealth network, on top of, the organizational structure of the Virginia Stroke System described in Section 2- Figure 7. The initial design is based on the classic telehealth huh-spoke configuration whereby the hospitals with the most advanced

stroke capabilities will serve as the "Hub", offering telehealth services to remote or smaller hospitals with lesser capabilities called "spokes". While the hub-spoke model will be the initial design, the goal is to modify the design as sites develop increasing capabilities. This means that a site might serve as a Hub and a Spoke under some circumstances.

The implementation and build-out of the tiered hub-spoke configuration of VAST will be done in phases. In Phase 1, Virginia's academic medical centers-- currently identified as both Comprehensive Stroke Centers (CSC-Level 1-VAST Tier 1) and Primary Stroke Centers (PSCs Level 2-VAST Tier 2) will be linked to each other. In Phase 2, as the PSCs are trained in tele-stroke practices and establish direct business relationships and connections with Tier 3, services will be extended out to basic and entry-level stroke hospitals, critical access hospitals, and community health centers in rural and underserved communities.

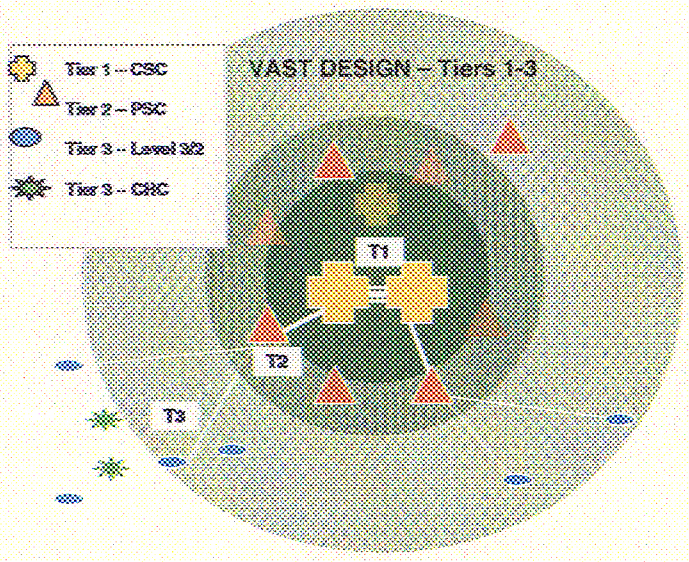


Figure 9 - VAST Hub-spoke design: Tier 1

Comprehensive Stroke Centers, Tier 2-Primary Stroke Centers, Tier 3's- Basic and Entry Level Hospitals and Community Health Centers

Site Selection

For purposes of the FCC Pilot, a total of 40 sites (with possibly 8 others- See Section 5) were selected for the initial planning and implementation phase. Eligible rural and urban providers have been selected with an emphasis placed on Critical Access Hospitals-- defined as a rural limited service hospital that has been converted to a special designation as a Critical Access Hospital under the Medicare Rural Hospital Flexibility Grant Program. The majority of CAHs are in Health Professional Shortage Areas and/or Medically Underserved Areas.

For the initial phase, hospitals and community health centers have been selected to participate in VAST. It is envisioned that services will be extended into other care environments over time (outside scope of FCC) to include; ambulances and medevac helicopters, doctor's offices, nursing homes, rehabilitation centers and patient homes to complete the VAST network.

Breakdown (See Appendix A – for the VAST Network Site List with RUCA Codes)

- Level 1/Level 2 - Comprehensive Stroke Centers: 5
- Level 3: 11 sites
- Level 4: 11 sites
- Community Health Centers: 13 rural-weighted, distributed within a close proximity and with an affiliation with a Level **3** or Level 4 hospital.

The majority **of** sites, 70%, were deemed "rural" by FCC criteria, and 100% were of non-profit status. Regional distribution reflected an emphasis on rural counties, with 35% of the sites in the southwest, 29% central, 20% north and 16% on the Eastern Shore of Virginia.

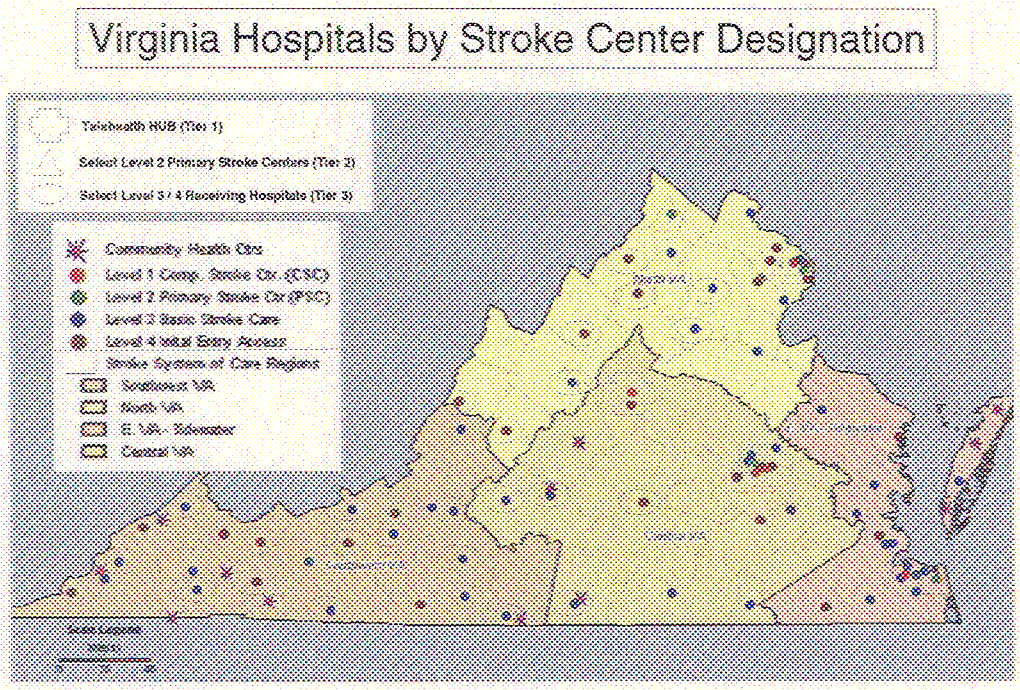


Figure 10 - VAST Clinical Network Design

Telehealth Applications for Stroke Systems

Using the stroke continuum of care depicted below, Virginia will design telehealth applications aimed at all phases of the continuum in efforts optimize the entire stroke system of care.

While some phases of the continuum include ineligible providers under FCC rules, they are described here for completeness in describing the larger utilization strategy for the VAST network.

Figure 11 - Stroke Continuum of Care and Associated Telehealth Applications

An array of telehealth applications will be introduced to complement existing traditional stroke interventions. While Tele-Stroke programs in other states focused specifically on the acute treatment portion of the stroke continuum, Virginia intends to take a more comprehensive and integrated approach.

Specifically, intensive interventions will be focused on those areas of the continuum that are linked to factors associated with that under utilization of stroke care systems which include:

- Poor patient recognition of stroke symptoms
- Delayed notification of emergency services
- Delays in patient transport

1. Prevention

Education & Training

Unfortunately, most Americans learn what the term "stroke" means by directly experiencing the devastating effects themselves, or by witnessing the effects on someone they care for. Stroke awareness messages can be reinforced through a range of educational applications which will be offered on the internet and/or by video-conferencing in community-based settings.

Health care professionals and first-responders also can benefit from continuing medical education addressing acute stroke recognition and treatment. A range of educational opportunities can be provided remotely to include: web-based training; broadcasting of interactive classes state-wide; collaborative neurovascular conferences and grand-rounds; and supervision and training of medical students and residents using video-conferencing equipment.

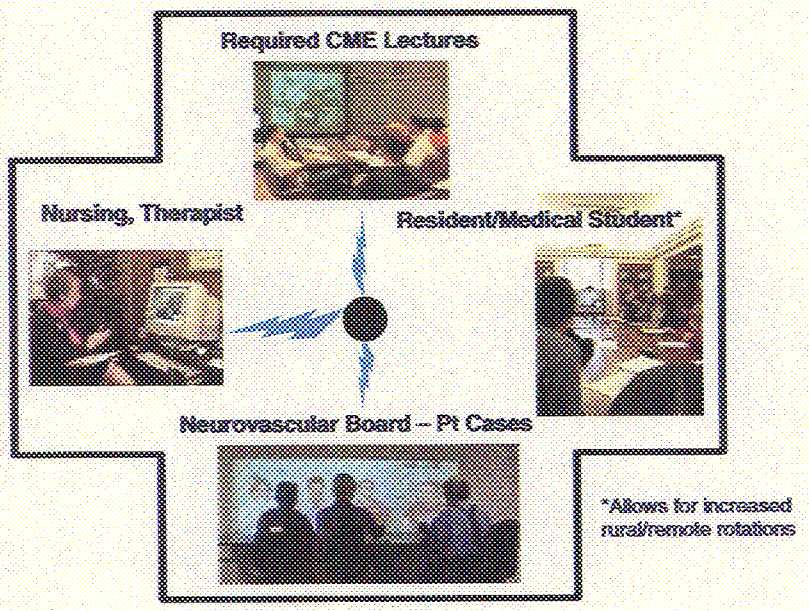


Figure 12 – Virtual Training and Education

Remote Medical Teleconsultation

There is a need for primary care providers (PCPs) to have access to medical specialists for remote consultation for assistance with diagnosing conditions and developing treatment plans. The three specialties which are most often consulting for stroke and related co-morbidities include:

- Endocrinology (diabetes, obesity)
- Cardiology (heart disease, high blood pressure and high cholesterol)
- Neurology (stroke)

PCPs can either interact with specialists via live video or by using secure email or web-based store-forward consultation systems. In addition to provider-to-provider consultation, patients can also be scheduled for a specialty consultation and have face-to-face visits using video-conferencing equipment. Their electronic health and laboratory data can be provided in advance or transmitted in real-time to facilitate the encounter.

Counseling

There are many types of individual and group counseling and patient education sessions that can be conducted remotely. For example, there is a severe shortage of diabetic educators and dieticians in Virginia. The existing model of broadcasting diabetes patient education, as has been deployed by the University of Virginia, can be expanded to serve patients throughout the Commonwealth.

2. Emergency Medical Services (EMS)

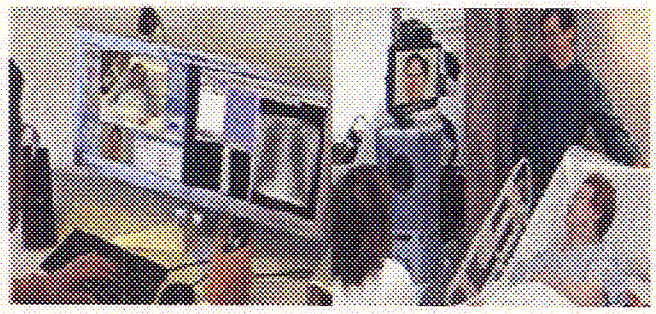
Currently this portion of the continuum of acute stroke intervention is not funded by the FCC Rural Health Care Pilot Program or the existing Rural Healthcare Support Mechanism. Ambulances and EMS facilities are not eligible providers. However, there are telehealth applications which could be implemented if broadband wireless connectivity were provided to every ambulance and helicopter. Given the duration of transport in some locations, first-responders/paramedics could connect with emergency departments to transmit vital signs and enable remote video-monitoring and physical inspection of patients in the pre-hospital setting by emergency room physicians located at Comprehensive and Primary Stroke Centers.

3. Acute Treatment.

A majority of the telehealth/telemedicine interventions initially will be focused in this element of the continuum. There are three main applications which will be used in combination to provide a total solution for acute stroke care. Following the Tele-stroke models from other states, three key applications will be used

- **Live Video-Teleconsultation**
  - Physicians at a Primary **Stroke** Center will consult via video with remote Emergency Department personnel to provide diagnostic support during the initial triage and treatment of a suspected stroke patient. Stroke Center experts can visually inspect patients to look for signs and symptoms of stroke and work virtually side by side with health care providers to deliver timely care.

- **Tele-radiology**
  - Transmission of CT scans from one facility to another
- **Web-based applications**
  - Electronic health record for stroke care with standardized protocols and order sets.



Michigan Stroke Network linking 22 rural hospitals with St. Joseph Mercy Oakland Hospital (Pontiac, MI)

Partners Health Care, Boston, MNA (Massachusetts General and Brigham and Women's) are linked to 14 rural sites.

Figure 13 - Tele-Stroke Model Programs

4. Sub-acute & Secondary Prevention

After a stroke has occurred, complications can follow. Experts can continue to observe and consult with patients and their physicians until discharge.

Figure 14 - Loma Linda Medical Center – Inpatient/ER Telemedicine Services

As evaluated in a recent NIH-sponsored trial, and in other studies, the transition from hospital to home is a high-risk period in a patient's illness (18-19). After discharge, patients either return home under the care of the primary care physician, or are transferred to a rehabilitation center. Either way, telehealth applications will ensure continuity of care and continued consultation and follow-up visits with healthcare

professionals regarding medications and on-going care. Further, telehealth applications can ensure the timely and accurate flow of information to the primary care physician at the time of patient discharge.

Figure 15 - Tele-Home Care for Patients After Stroke.

As noted by the Agency for Healthcare Research and Quality (AHRQ), "any process that improves information transfer among providers at discharge might improve the health and safety of patient discharged from US hospitals each year" (20).

5. Rehabilitation

If patients are transferred to a skilled nursing facility or other center for further care and rehabilitation, telehealth applications can aid in that transition by ensuring communications between the health care teams to ensure a smooth hand-off and coordination of care.

6. Continuous Quality Improvement

Healthcare providers will be using a range of software and hardware to conduct telehealth services. Likewise, they will be using protocols and procedures for conducting telehealth and telemedicine applications. The use of equipment and the associated clinical business practices and conduct on the network will need continuous monitoring and evaluation. State-wide meetings can be held at a distance to facilitate peer-review, supervision of practices and to conduct in-services and ongoing equipment training to ensure standards of care.

Technical Design

The following graphic provides a high-level technical view of the VAST network. Equipment for the hub and spoke sites is illustrated as well as the broadband connection that enables telehealth applications to operate.

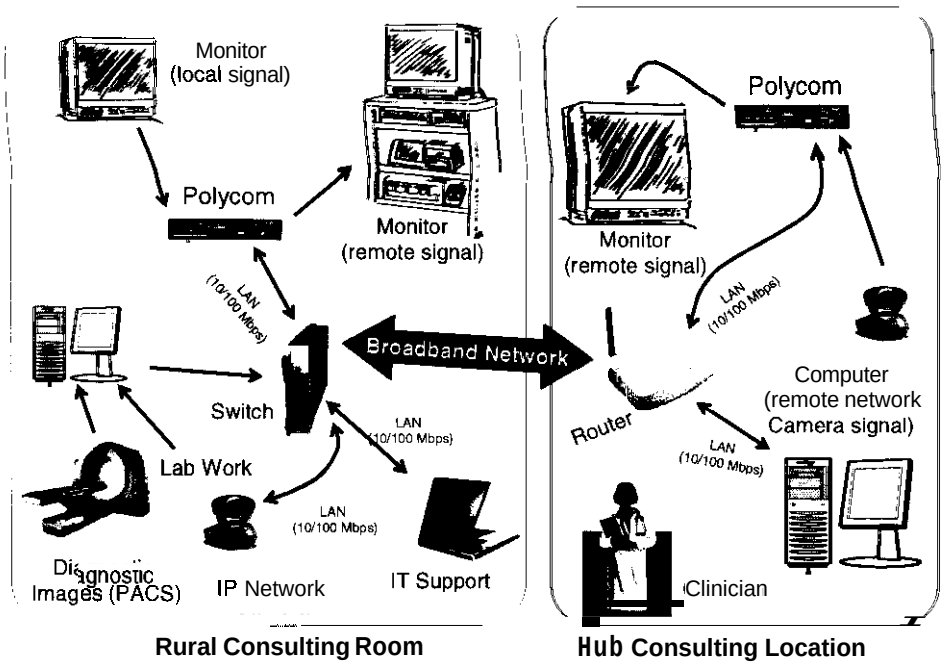


Figure 16 - Technical View of the VAST Network

This section described the operational architecture and telehealth applications of the VAST Network. Given the current state of stroke care, and the likelihood of major advancements in stroke therapies on the horizon, it is urgent that measures he taken to create mechanisms for connecting patients to stroke systems of care — from ANY location in Virginia--for rapid identification, assessment and treatment. Further, health care providers must be trained on best practices and the latest treatments in order to ensure that care is delivered effectively once a patient enters the stroke system.

An enabling technological and telecommunications infrastructure that provides the capabilities to remotely educate and train health professionals and diagnose and treat stroke will significantly mitigate the widespread disparities in rural and underserved communities in Virginia. The following section will discuss the technical approach to the telecommunications network that will support VAST.

[redacted]

4.0 Network Plan

4.0 NETWORK PLAN

Virginia will adopt a forward-thinking design for the Virginia Acute Stroke Telehealth (VAST) network; not only deploying an advanced telehealth network, but also developing a unique "best practices" model with demonstrable and quantifiable results that can be replicated by other States.

Virginia has thoughtfully designed a network that facilitates the clinical business goals and objectives of VAST, meets the functional and technical requirements laid out by the Virginia Telehealth Network, and leverages legacy and advancing telecommunications infrastructure. The network strategy takes two approaches to exploring *long-term* solutions for healthcare users—a migration strategy from ATM to MPLS that is operated and managed by a dedicated Telehealth Network Operations Center (NOC) at UVA, and a direct connection to the state's new MPLS network managed by Northrop Grumman.

Virginia Telehealth Network

Virginia has been collaborating on telehealth activities at a state-level for the past 4 years. First conceived in ***2002,*** the Virginia Telehealth Network—a collaborative network of professionals—began exploring ways to address health needs through the use of telehealth and telemedicine applications. To date, organizational development of the VTN bas been pursued and championed through the interests and active participation of organizations and individuals throughout the Commonwealth, including:

- Academic medical centers
- State organizations involved with health care
- State and local government entities
- Regional organizations involved with health care
- Colleges, universities and foundations
- Health care professionals

Currently, the VTN represents more than 80 organizations from throughout the Commonwealth who have the desire and ingenuity to make quality health care accessible to more Virginians. Acting as their collective voice, the VTN helps set a direction and standards for not only establishing user connectivity, but for the processes and content that ultimately drive telehealth acceptance and usability by both health care providers and patients alike.

During its developmental stages, the VTN operated under the auspices of the Virginia Department of Health (VDH). Through the ongoing, strong support of senior government and healthcare leaders and through the dedication of its grass-roots membership, in 2006 the VTN became an independent corporation in the Commonwealth of Virginia. The VTN is now in the process of being recognized as a 501(c)(3) not-for-profit organization to demonstrate and facilitate its alignment with public interests.

Developing Functional and Technical Requirements

Recognizing the essential role that affordable infrastructure plays in the successful deployment of telehealth/telemedicine applications, in 2003- 2004 the VTN formed an Infrastructure Work Group (IWG) to assess the current telehealth infrastructure and capacity, and develop future plans for expansion of telehealth activities. Based on the findings of the site survey, a white paper was developed by the VTN IWG recommending the "**development of an integrated statewide telehealth network infrastructure and organization designed to meet the present and future needs of all VTN members".** In September 2005, a Strategic Planning Team was formed to identify the high-level system requirements for the network recommended by the VTN IWG with the idea that the VTN would itself stand-up and operate a dedicated telehealth network to provide customized support for those accessing telehealth services. Core recommendations for the telehealth network included:

The Telehealth Network shall;

- Supply Internet Protocol (IP) based MultiProtocol Label Switching (MPLS) services, utilizing existing telecommunication network facilities.
- Be available to all public and private healthcare related organizations and individuals
- Provide a flexible, scalable, manageable, secure and cost-effective network infrastructure capable of linking healthcare providers and patients within Virginia, as well as nationally and internationally.
- Provide 24/7 access to technical assistance for interconnectivity problems that have in the past created obstacles to the adoption of telehealth services.
- Provide a comprehensive means in Virginia to ensure full-scale interactive broadcast messaging to health service providers in times of public health emergencies.
- Provide the necessary infrastructure for patient health record exchanges.

In fall 2006, the VTN IWG requested that VTN assemble a clinical work group to define the specific functional requirements of the developing state-wide telehealth network. It was during the period that the

clinical work group was conducting research and formulating recommendations that the FCC Rural Healthcare Pilot Program was released. At that time, it was decided that the Virginia Acute Stroke-Telehealth (VAST) Model would be the focus of the Commonwealth's FCC application and serve as an initial organizing framework for the development of telehealth functional requirements. Following are the high-level functional requirements for the initial implementation of the VAST network.

The VAST network shall:

- Provide a ubiquitous network linking Level **3** and Level 4 Stroke Centers to each other, to allow the seamless flow of medical data and images to and from all nodes on the network statewide.
- Transmit a diagnostic-quality radiology image (CT scan- averaging 70MB) between designated stroke centers within 15 minutes to support the delivery of acute stroke diagnosis.
- Support the concurrent utilization of four main data formats for purposes of delivering high-quality medical care; 1) radiology, 2) High Definition video-teleconferencing, **3)** Web-based applications and 4) voice.
- Provide a platform through which rural facilities have affordable access to the advanced research and computing resources and capabilities available on Internet2 and National Lambda Rail networks.

The pioneering activities of the VTN have provided a strong technical and clinical base upon which the VAST proposal now stands. By coalescing stakeholders and providers the VTN has developed the requisite state-wide partnerships for coordinating telehealth services that can be leveraged to insure the success and sustainability of the VAST Network. Furthermore, the early efforts to document and validate functional and technical requirements, bas set the stage for the initial network design.

Approach

Since the VTN IWG made its initial recommendations, the telecommunications industry has undergone rapid change – both in technology advancements and in areas served. **In** keeping pace with the industry, the Commonwealth of Virginia has also evolved its networking and service capabilities, resulting in a very different landscape than initially examined and documented by the VTN. These factors lead the UVA team to conduct a careful review of the existing and planned state infrastructure so that the proposed VAST network could be designed in a manner that will allow for maximum usage of existing/planned infrastructure rather than spend dollars on "overbuilding". Existing infrastructure to he leveraged by VAST includes: two existing state networks (Network Virginia, COVANET), open access

networks funded by the Virginia Tobacco Commission, and the emerging Commonwealth/Northrop Grumman MPLS network. Detail on each of the legacy networks can be found in Appendix F. Further discussion regarding the status of the State's transformation efforts is provided in Section F as well.

The Future – Commonwealth Network Transformation

As part of a 10-year, technology transformation partnership between the Commonwealth of Virginia and an industry team led by Northrop Grumman Corporation, the Commonwealth is working to build a single, statewide managed network to support all government services. Through a multi-million dollar investment, the state will migrate from network technology that is fragmented and inconsistent among state agencies, and reduce from 85 inconsistent internet connections to two consolidated, secure, and reliable connections with one centralized multi-service network. The new statewide network will be more robust, reliable and secure. The network transformation is occurring with the introduction of Multiprotocol Label Switched (MPLS)[1] which provides an expandable extensible fabric, allowing for a tighter integration among and between the services as well as allowing Commonwealth agencies to more seamlessly integrate support services across all levels of government throughout Virginia.

Upon completion, the new MPLS managed network will support over 1,900 locations throughout Virginia (Figure 19), managed by two state-of-the-art operations centers located in different regions of the state, and support all government operations, including human services, health solutions, public safety, transportation, and other key citizen support services.

Figure 17 - COVANET Today and MPLS Network by 12/31/08

[1] Access to an MPLS is not restricted to Northrop Grumman. Verizon (as well as other providers) are capable of/are deploying similar applications in Virginia. Verizon and Virginia Tech will be partnering with VAST to provide access to their MPLS solution

How Do We Get There - Transformation Efforts Underway

In 2005, The Commonwealth of Virginia and Northrop Grumman formed a partnership to modernize the state's information technology infrastructure. Called the Virginia IT Infrastructure Partnership (ITIP) the partnership is tasked with providing innovative ideas to meet the needs of the Commonwealth. Through the ITIP, state government agencies, regardless of size and budget, are provided expanded offerings and reliable services at predictable prices as a result of the partnership's enterprise and integrated approach to IT service delivery. This technology transformation is being accomplished without additional cost to taxpayers through a $270M investment from Northrop Grumman.

The three-year transformation process that began July 1, 2006, will bring a reliable, high-performance and enterprise-wide IT infrastructure to the Commonwealth. Transformation will mean that state agencies receive consistent, reliable and measurable services. Transformation projects include (but are not limited to): desktop refreshes with compatible platforms and scheduled replacement; network and server modernization and consolidation; enhancement of information security; common messaging, and help desk services. See Figure 18 for a conceptual view of the MPLS network transformation.

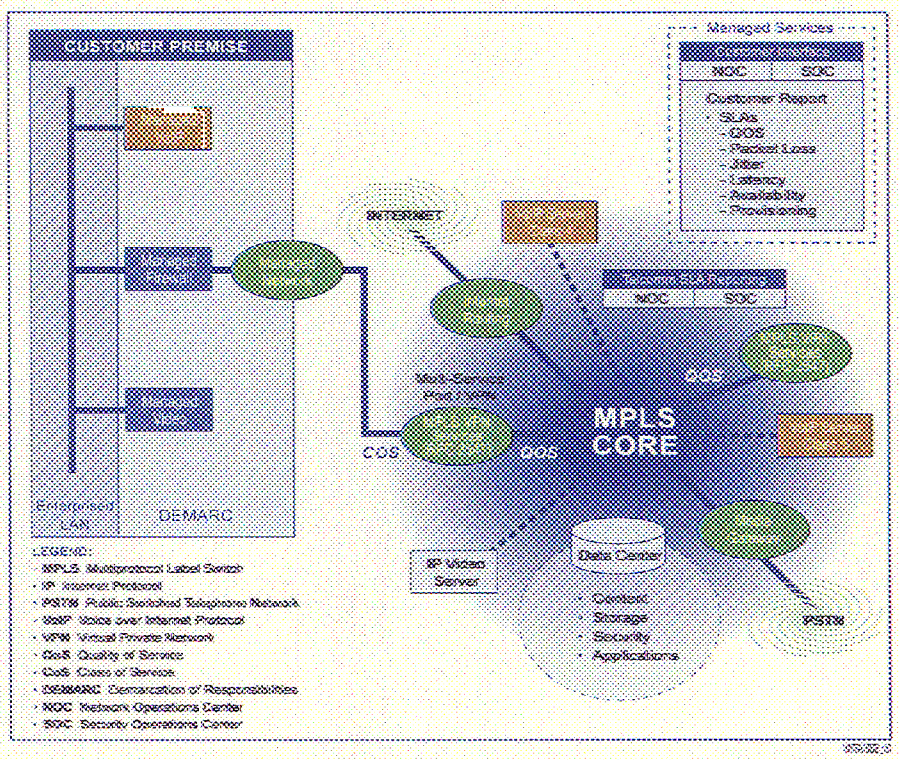


Figure 18 - Virginia's Integrated MPLS VPN Architecture

ultimately the Commonwealth (through the ITIP and the consolidated network) will be able to support the two new data centers and integrate all network services through common multiservice ports. The bottom line for the Commonwealth is that this single MPLS network will reduce cost, enhance functionality, and simplify operations.

Status of the MPLS Roll-out

At the time of submission, the core network is complete. Further implementation is underway using a phase-approach with 15% of the targeted sites being migrated to the state's MPLS network per quarter. The roll-out is not agency based, but is being done on a regional basis, with a goal of having all 1900 sites transitioned by 2009. Presently, the Virginia Department of Health sites. and other healthcare-related organizations have not migrated.

All of the legacy and future networks have been examined and considered during the development of the proposed VAST network. Each will play a critical role in the successful deployment of the VAST infrastructure, and because of the different types of broadband technologies available, will allow for the testing of different configurations and cost models that once optimized can ultimately serve as a customizable and replicable model for others to follow.

Considerations

Early in the design process, the team believed that a complete migration of the participating VAST sites to the state's MPLS network would he the most desirable solution. However, after close examination, the following factors, deemed a complete cut-over to be the state's MPLS neither feasible nor cost effective.

- The State's MPLS network is private, meaning that users on the network can only talk to each other. During a transition period, some healthcare providers would be "cut off' from others. Undertaking a migration will require careful planning and analysis, and is simply too far to go for the Pilot program.
- Commonwealth's MPLS solution's phased (and regional) roll-out schedule is still on-going. Currently there are no healthcare providers using that network
- Many of the healthcare sites are engaged in contractual relationships with other providers and would have to bear additional costs to participate in the state's MPLS solution.
- Limited duration of the pilot

Having considered numerous **odons**, the technical team decided to develop a very flexible interim "hybrid" network focused **on** the goal of maximizing inclusion (number of sites connected) and achieving the highest quality of service, The flexible design also includes a limited number of connections to both the NetworkVirginia and the NG/Commonwealth of Virginia MPLS networks, which will allow for benchmarking and analysis of network and service delivery approaches. While migrating healthcare providers to an MPLS network remains the long-term vision (pending successful pilot outcome), it was simply too far to go and too disruptive to the healthcare providers to undertake as the first step in deploying the network in support of VAST.

The Solution

As previously noted, the long-term plan is to migrate all[2] VAST participants to a broadband MPLS network. **MPLS** fuses the intelligence of routing with the performance of switching and provides significant benefits to networks with a pure IP architecture, as well as, those with IP and ATM or a mix of other Layer *2* technologies. MPLS technology is key to scalable virtual private networks (VPNs) and end-to-end quality of service (QoS), enabling efficient utilization of existing networks to meet future growth and rapid fault correction of link and node failure. The technology also helps deliver highly scalable, differentiated end-to-end IP services with simpler configuration, management, and provisioning for both Internet providers and subscribers. The key points for the network implementation are Quality **of Service** and security, both of which will be essential to the VAST applications and necessary to meet current HIPAA requirements. The technical benefit to VAST is the ability to increase the bandwidth at the remote sites for High Definition Videoconferencing and rapid transmission of CT images to the primary stroke center. MPLS will enable **us** to go from just over 1.5Mbps to 6Mbps without greatly increasing the monthly recumng costs. **As** the Commonwealth of Virginia/NG builds out its fiber network and the clinical need dictates evolution to greater bandwidths will occur.

As an initial step for the pilot, the UVA Office of Telernedicine will transform their existing telehealth network (including client connections) from a strictly ATM based network to an MPLS environment. Transformation will occur in three (simultaneous) stages:

- **Stage 1** - Working with partners at both Northrop Grumman and NetworkVirginia, (see "NOTE' below) a total of nine (9) sites will be migrated to MPLS
- Stage 2 - Other sites will have connections upgraded to a higher bandwidth capacity.

[2] Including sites currently deployed on Network Virginia, participating in the UVA Telemedicine Network, or part of the design completed by the VTN-IWG.

- **Stage 3** - The remaining sites (primarily community health centers) of the UVA telemedicine network will continue to be served by their existing DS1 service (See Figure 19).

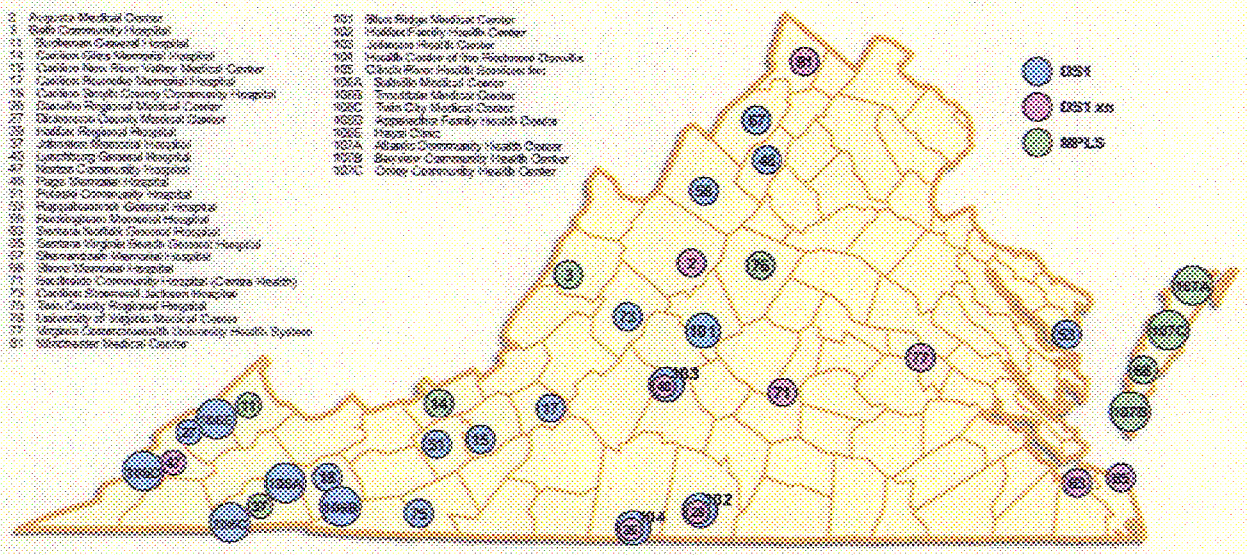


Figure 19 - Proposed VAST Network Deployment

The purpose of using two different entities for deploying MPLS (NetworkVirgina/Verizon and Northrop Grumman) is to use this pilot to evaluate two different network management theories as follows:

A. **Non-dedicated Technical Resource for Telehealth**-The Northrop Grumman deployed MPLS will have the routers and the network monitored and maintained by Northrop Grumman at their NOC. The Northrop Grumman NOC will serve these sites along with their other non-healthcare users. Northrop Grumman will provide limited access to UVA Telemedicine to a switch at each remote site so that UVA can monitor the end-user telemedicine devices.

B. **Dedicated Resource for Telehealth**-Under the Network Virginia/Verizon installation, the University of Virginia Telemedicine Network Operations Center (NOC) will continue to maintain and monitor the routers, switches, firewalls and end-user telemedicine devices at the remote sites. The UVA NOC is dedicated to healthcare users, has direct communications and relationships with providers, and understands telehealth applications and the unique healthcare environments in which they operate.

An evaluation will be conducted over the term of the pilot project to ascertain which approach is the most cost effective, efficient and appropriate for the clinical needs of the network.